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Late Llandovery (early Silurian) dendroid graptolites from the cotton formation near Forbes, New South Wales

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Abstract

A well-preserved dendroid graptolite fauna of Early Silurian (late Llandovery: probable turriculatus graptolite zone) age is described from the Cotton Formation near Forbes, New South Wales. A possible rhabdopleuran hemichordate is described from Australia for the fi rst time. The fauna consists of 13 taxa as follows: Dendrograptus sp. aff. D. avonleaensis, Dictyonema zalasiewiczi sp. nov., Dictyonema sp. aff. D. paululum australis, Dictyonema paululum australis, Dictyonema sp. aff. D. sp. cf. D. venustus of Bulman (?ssp. nov.), Dictyonema venustum, Dictyonema sp. cf. D. falciferum, Callograptus bridgecreekensis, Callograptus rigbyae, Callograptus sp. aff. C. ulahensis, Stelechocladia sp. cf. S. praeattenuata, Acanthograptus praedeckeri and ?Rhabdopleura sp. (? with zooids). The fauna is close in composition (although less diverse) and age to a dendroid fauna recently described from Bridge Creek near Orange, NSW, which was assigned to the slightly younger griestoniensis zone.

Keywords

Cotton Formation, dendroids, Early Silurian, Forbes, graptolites, New South Wales, GeoQUEST

Disciplines

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Late Llandovery (Early Silurian) Dendroid Graptolites from the Cotton Formation near Forbes, New South Wales

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A well-preserved dendroid graptolite fauna of Early Silurian (late Llandovery: probable *turriculatus* graptolite zone) age is described from the Cotton Formation near Forbes, New South Wales. A possible rhabdopleuran hemichordate is described from Australia for the first time. The fauna consists of 13 taxa as follows: *Dendrograptus* sp. aff. *D. avonleaensis*, *Dictyonema zalasiewiczi* sp. nov., *Dictyonema* sp. aff. *D. paululum australis*, *Dictyonema paululum australis*, *Dictyonema* sp. aff. *D.* sp. cf. *D. venustus* of Bulman (?ssp. nov.), *Dictyonema venustum*, *Dictyonema* sp. cf. *D. falciferum*, *Callograptus bridgecreekensis*, *Callograptus rigbyae*, *Callograptus* sp. aff. *C. ulahensis*, *Stelechocladia* sp. cf. *S. praeattenuata*, *Acanthograptus praedeckeri* and ?*Rhabdopleura* sp. (? with zooids). The fauna is close in composition (although less diverse) and age to a dendroid fauna recently described from Bridge Creek near Orange, NSW, which was assigned to the slightly younger *griestoniensis* zone.

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KEY WORDS: Cotton Formation, dendroids, Early Silurian, Forbes, graptolites, New South Wales.

INTRODUCTION

The dendroid graptolites described here have been collected over many years by one of us (GT) from a quarry in the Cotton Formation at Cotton Hill near Forbes in western N.S.W. Fossils from these beds have been described by Sherwin (1974: graptolites) and Edgecombe and Sherwin (2001: trilobites). The described trilobite and graptolite faunas are from beds exposed in the quarry high in the upper part of the Cotton Formation (Sherwin 1974) and the graptolite fauna is correlated with the late Llandovery (Early Silurian) *turriculatus* graptolite zone (Edgecombe and Sherwin 2001). Despite the very nature of collections made in an active quarry, there seems little doubt that the bulk of the dendroid fauna and the graptoloids are from the same narrow horizon. The most similar known dendroid fauna was described by Rickards et al. (2003) from the Four Mile Creek district, south of Orange, NSW, and comparisons are made below with that fauna.

AGE OF THE ASSEMBLAGE

Although the Cotton Formation dendroid fauna (13 species and subspecies) is less diverse that described from the Bridge Creek localities in the Four Mile Creek district (24 species and subspecies) by Rickards et al. (2003), there can be little doubt that the two faunas are close in age. The largest assemblage at Bridge Creek, from locality F14, was referred by Rickards et al. (2003) to a horizon low in the *griestoniensis* graptolite Zone. The Cotton Hill fauna is assigned almost certainly to the stratigraphically lower *turriculatus* graptolite zone.

Of the fauna we record here from the Cotton Formation, only *Dictyonema zalasiewiczi* sp. nov. and *?Rhabdopleura* sp. have not been recorded from Bridge Creek at locality F14. *Callograptus ulahensis* Rickards et al., 2003 was recorded from a lower (*gregarius* Zone) assemblage at locality BF15 on Bridge Creek: the Cotton Hill Quarry species is referred to *Callograptus* sp. cf. *C. ulahensis*.

Stelechocladia praeattenuata Rickards et al., 2003 was not recorded from F14 but occurs below (F19) and above (BF28, BF24 and BF18), ranging from the *gregarius* Zone to the uppermost *griestoniensis* Zone. Sherwin (1973, 1974) referred the strata at Cotton Hill Quarry to the *turriculatus* Zone, with some levels probably earlier than this but without definite faunas. Sherwin (1970, 1973) also recorded *Dictyonema* spp. from the highest band of a group of beds yielding a likely *turriculatus* Zone fauna. Hence the two dendroid assemblages, from Cotton Hill (probable *turriculatus* Zone) and from Bridge Creek (*griestoniensis* Zone), are not dissimilar in age, the Cotton Hill fauna being about one graptolite zone lower.

There is another difference between the two assemblages apart from a possible slight age difference and a diversity range, and that is that the Cotton Hill fauna is almost exclusively of slender, delicate species, often broken. In contrast, most of the species described by Rickards et al. (2003) from Four Mile Creek are robust, and are preserved in poorly bedded siltstone. The only robust form common to the two localities is *Stelechocladia* and at Cotton Hill it is known only from three small fragments showing distal, slender thecae. It is possible that the Cotton Hill assemblage lived in a quieter depositional environment, such as a lagoon, or further offshore. Edgecombe and Sherwin (2001) concluded that the laminated siltstones that dominate the formation were deposited in a 'very calm' environment, 'most likely below storm surge wave base'.

Associated graptoloids. Sherwin (1970, 1973) was the first to identify graptoloid species from the Cotton Beds, following the initial recognition of graptolites from this locality by Packham (1967). Sherwin (1970, 1973) recognised two faunas, an earlier assemblage (his fauna C) and a later assemblage (his fauna D) respectively from the east and west quarries on Cotton Hill: both are in the upper Cotton Formation. Fauna D, from the western, larger quarry, includes *Dictyonema* sp. (Sherwin 1973, fig. 10). Some mixing of faunas possibly occurred because collection was from large blocks on the quarry floor (Sherwin 1974, p. 149). It is this western quarry from which the present collection of dendroids came; the eastern, smaller, quarry has not so far yielded dendroid graptolites.

The graptoloid assemblages were described in detail by Sherwin (1974) and, allowing for some possible mixing of faunas, the overall aspect is of a *turriculatus* Zone fauna, perhaps rather low in that horizon given the presence of *Rastrites linnaei*, *Monograptus halli*, and *Monograptus* sp. cf. *M. sedgwickii*. Thus the Cotton Hill quarry is at a stratigraphically lower level than the Four Mile Creek (F14) locality which was mentioned in the preceding section and which is probably low in the *griestoniensis* Zone.

Graptoloids occurring on the same rocks as the Cotton Hill dendroids described below include: *Parapetalolithuspalmeus*,*?Glyptograptustamariscus*, *Monograptus andrewsi* and *Spirograptus turriculatus* (Fig. 7b). The faunal lists given by Sherwin (1974) are fuller and much more reliable than the graptoloids at our disposal. Here we also record and illustrate (Fig. 7a) *Parapetalothius palmeus* (Barrande, 1850), a form not recorded by Sherwin (1974); its occurrence accords with his age attribution of the *turriculatus* zone. In their revision of *Spirograptus*, Loydell et al. (1993) assigned Sherwin's (1974) *Monograptus turriculatus* (Barrande, 1850) to their new species *Spirograptus guerichi*. They further (Loydell et al. 1993, p. 924, text-fig. 7) stated that *S. guerichi* is "virtually confined to its biozone", whereas *S. turriculatus* ranges through their *turriculatus* biozone into the *crispus* biozone; Sherwin (1974, p. 150) shows that both species occur in his fauna D.

SYSTEMATIC PALAEONTOLOGY

This benthic graptolite fauna has been assembled only by sustained and diligent collecting over many years by one of us (GT), as dendroids are rare at the locality. The preservation is of reddish brown graptolites against a very pale, fine-grained siltstone or mudstone. The specimens are often large but are mostly fragmentary, and there seems to be little in the way of burial distortion or twisting and no obvious tectonic deformation. Some specimens are preserved in three dimensions infilled, probably with goethite: in others the periderm is diagenetically flattened, but with some parts (e.g. stolons) pyritised. It is possible that in some instances pyritised zooids are present. Rarely stolons occur free on the bedding plane, the surrounding periderm having degenerated; this situation has been noted by Chapman et al. (1993) and Rickards et al. (2003). All specimens are deposited in the Australian Museum, Sydney, with numbers AM F123381-123428.

Subphylum Pterobranchia Lankester, 1877 (*nom. trans*. Rickards and Durman 2006)
Class Graptolithina Bronn, 1849
Order Dendroidea Nicholson, 1872
Family Dendrograptidae Roemer *in* Frech 1897

***Dendrograptus* J. Hall, 1858**

Type species

Graptolithus hallianus Prout, 1851, subsequently designated by J. Hall (1862).

***Dendrograptus* sp. aff. *D. avonleaensis* Rickards et al., 2003**

Figures 1a, 3a

Synonymy

aff. 2003 *Dendrograptus avonleaensis* n. sp.; Rickards et al., pp. 312-3, figs 5A, 6A.

Material

AM F123381.

Description

The single specimen shows nine stipes and five

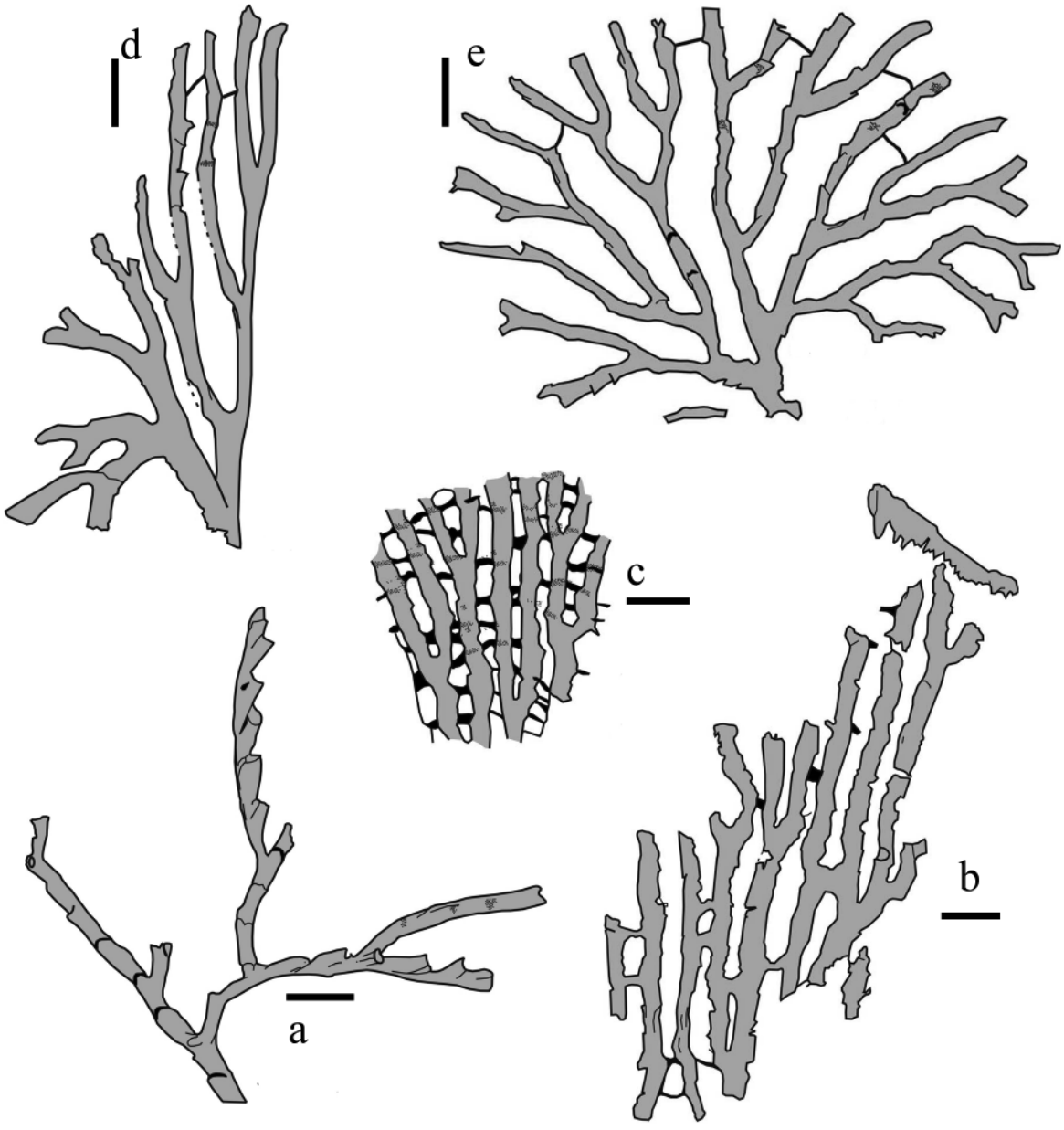

Figure 1. a, *Dendrograptus* sp. aff. *D. avonleaensis* Rickards et al., 2003; AM F123381. b, *Dictyonema* sp. aff. *D.* cf. *venustum* Bulman, 1928; AM F123398. c, *Dictyonema zalasiewiczi* sp. nov., holotype AM F123402; d, *Callograptus bridgecreekensis* Rickards et al., 2003; AM F123403. e, *Callograptus rigbyae* Rickards et al., 2003; AM F123406. Black bars are dissepiments; black rods, arched in ventral views, are autothecal ventral processes. Scale bars 1 mm.

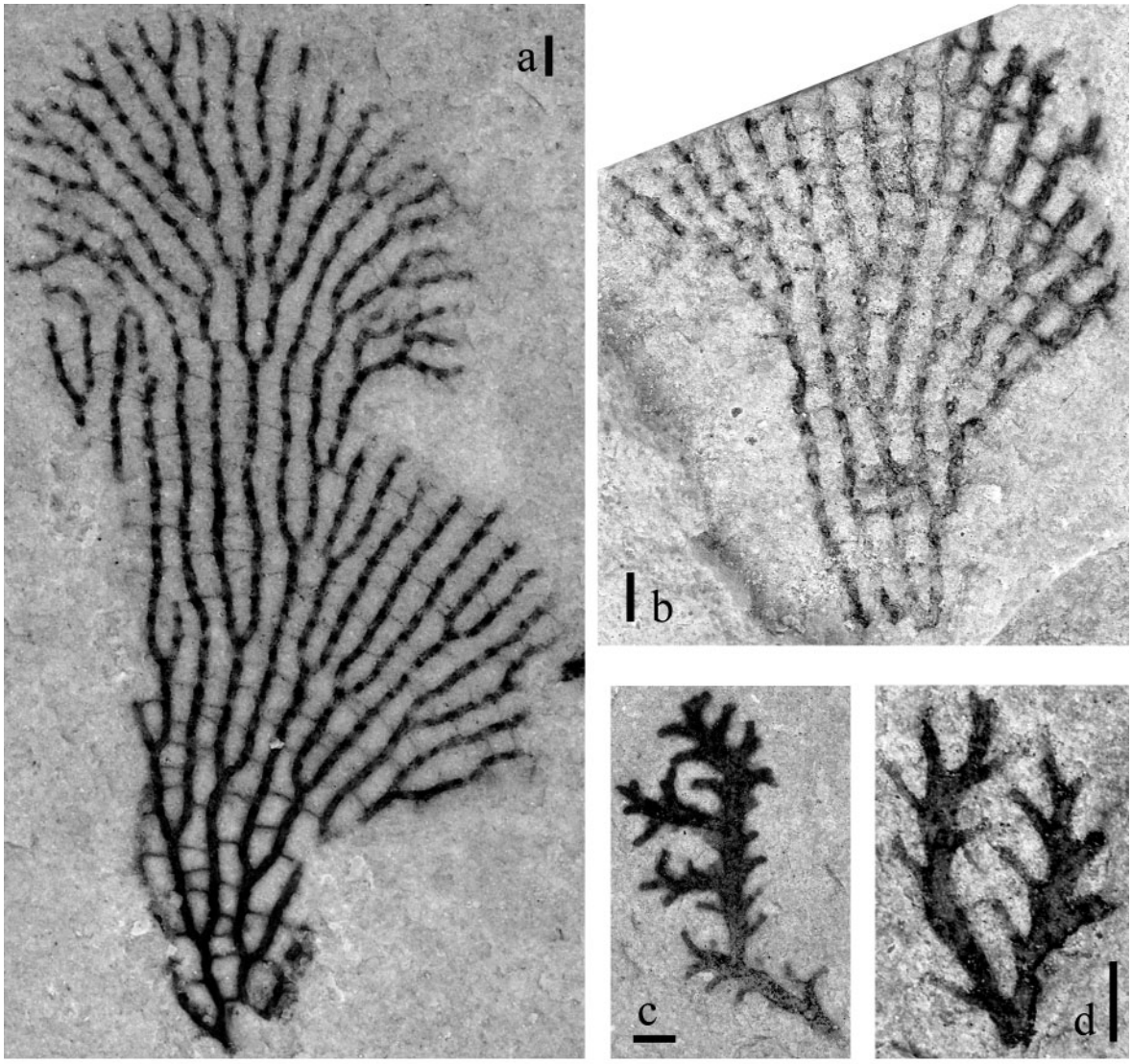

Figure 2. a-b, *Dictyonema paululum australis* Rickards et al., 2003, respectively AM F123382, AM F123383. c-d, *Acanthograptus praedeckeri* Rickards et al., 2003, respectively AM F123411, AM F123410. Scale bars 1 mm.

branching points in mostly ventral view, but also shows autothecal profiles in places. Specimen almost flattened diagenetically, but periderm still slightly transparent. 15-20 autothecae in 10 mm, with a profile width of 0.2 mm, and a fairly simple aperture slightly arched ventrally as seen in the ventral view. Bithecae exceedingly inconspicuous, being tiny tubes opening externally alongside autothecal apertures and alternating along stipe. Branching of stipes may be in zones at 1-3 mm intervals; stipe lateral width 0.30 mm and dorsoventral width 0.40 mm.

Remarks

This specimen, probably representing the distal-most parts of the colony, agrees closely with the type material of *D. avonleaensis* in most characters, especially the roughly zonal branching, autothecal nature and spacing and stipe dimensions. The type specimens from Bridge Creek (Rickards et al. 2003) had much of the proximal region preserved, and this is much more robust than the Cotton Hill material.

Dictyonema J. Hall, 1851

Type species

Gorgonia retiformis J. Hall, 1843, subsequently designated by Miller (1889).

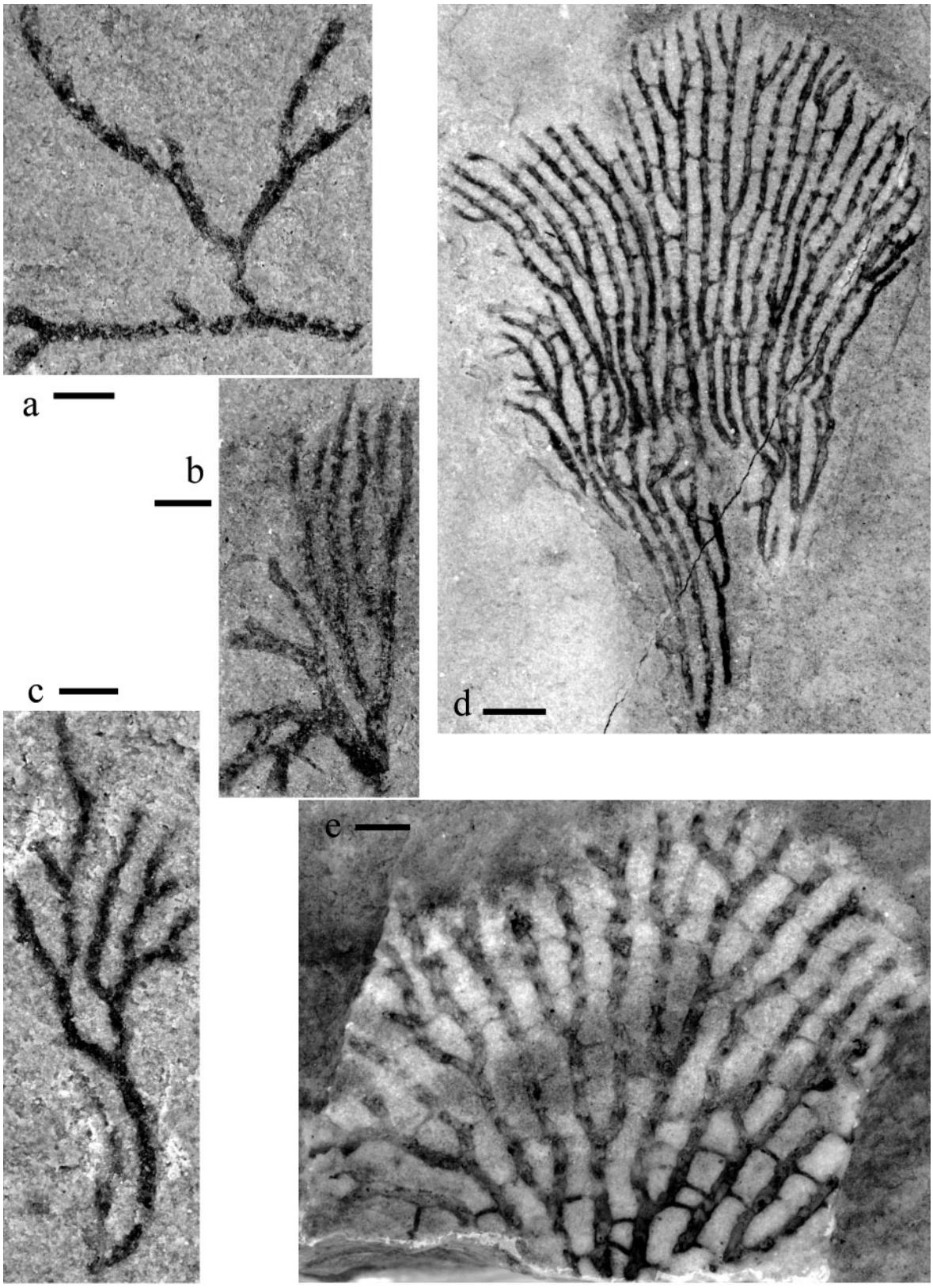

Figure 3. a, *Dendrograptus* sp. aff. *D. avonleaensis* Rickards et al., 2003; AM F123381. b, *Callograptus bridgecreekensis* Rickards et al., 2003; AM F123403. c, *Callograptus* sp. aff. *C. ulahensis* Rickards et al., 2003; AM F123407. d, *Dictyonema* sp. cf. *D. falciferum* Bulman, 1928, AM F123401. e, *Dictyonema paulum australis* Rickards et al., 2003; AM F123386. Scale bars 1 mm.

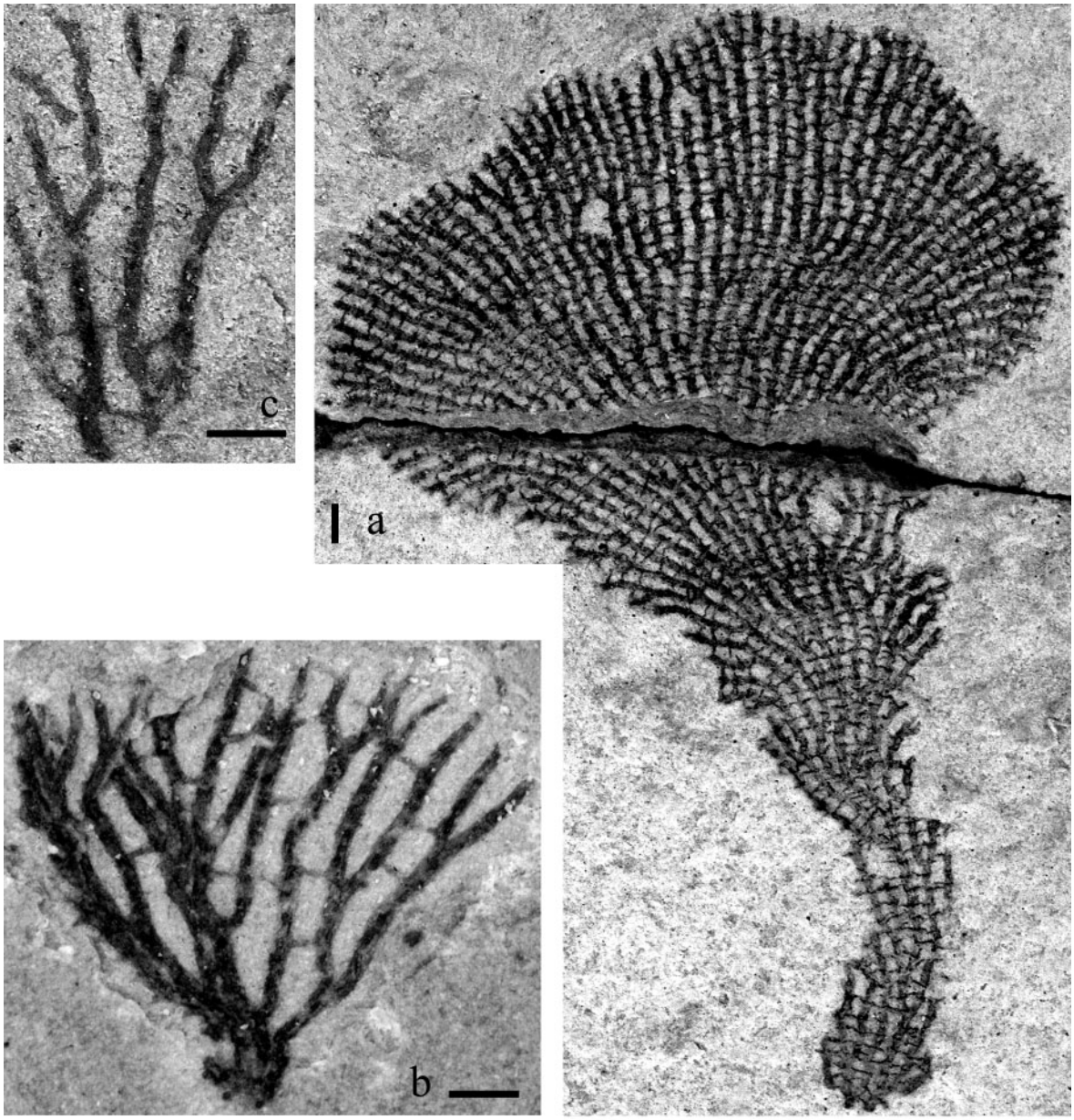

Figure 4. a, *Dictyonema zalasiewiczi*, sp. nov., holotype AM F123402. b, *Dictyonema venustum* Lapworth, 1881; AM F123397. c, *Dictyonema paululum australis* Rickards et al., 2003, respectively AM F123385. Scale bars 1 mm.

***Dictyonema paululum australis* Rickards et al., 2003**

Figures 2a-b, 3e, 4c, 7c

Synonymy

2003 *Dictyonema paululum australis* n. subsp., Rickards et al., p. 316, figs 7F-G, 9E, 12A.

Material

Twelve specimens, AM F123382-93, ranging from small fragments to almost complete colonies.

Description

Probably fan-shaped rhabdosome of slender stipes, no indication of a conical colonial arrangement; colony with slender, parallel stipes, only approximately branching in zones, sometimes fanning out in rapid expansion. Stipes branch at intervals of 1.5-3.0 mm; stipe lateral width 0.20-0.25 mm proximally, 0.15 mm more distally; dorsoventral width 0.50-0.60 mm; stipe spacing 13-16 in 10 mm, stipe interspaces 0.50-0.60 mm. Autothecae denticulate, 18-20 in 10

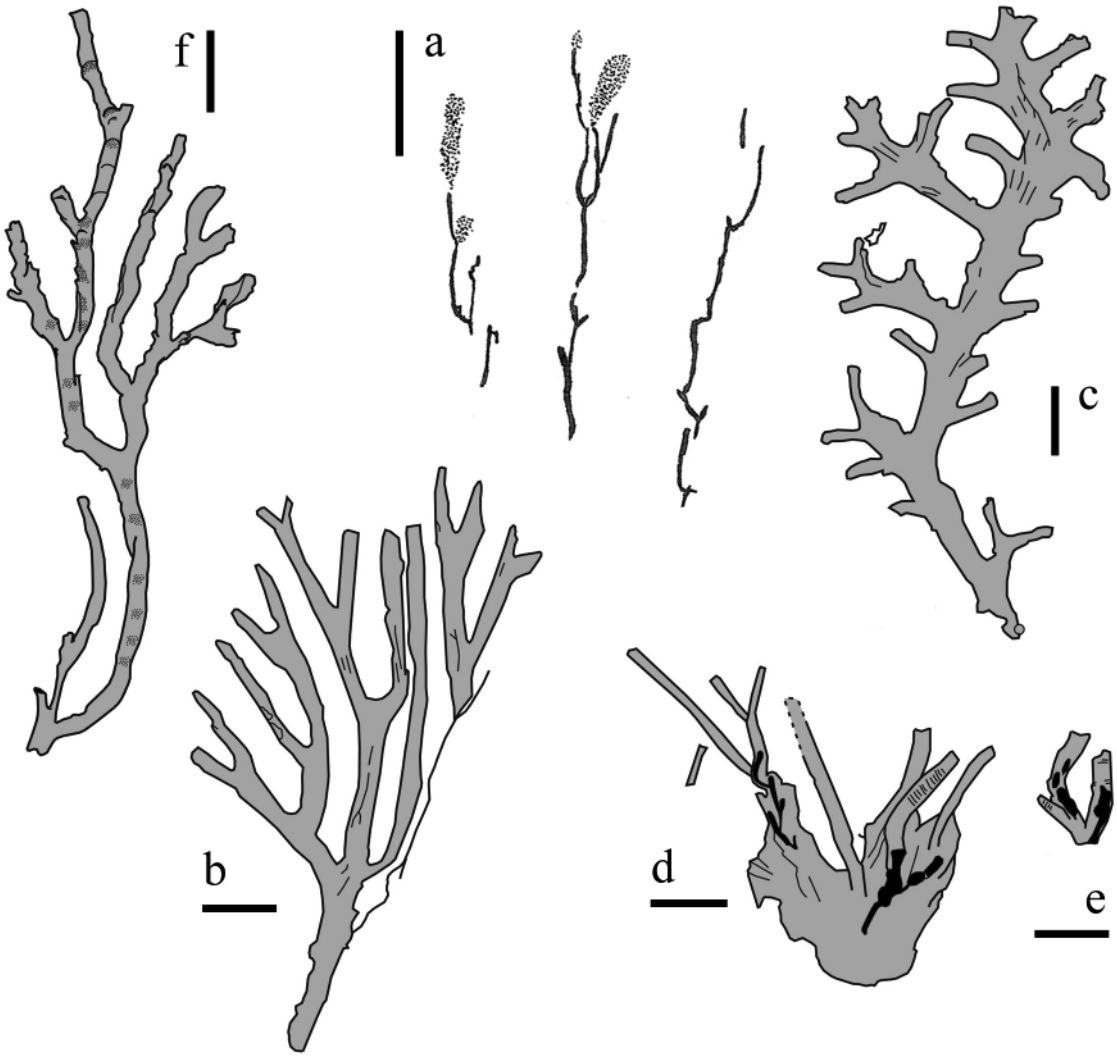

Figure 5. a, *Dictyonema* sp. cf. *D. falciferum* Bulman, 1928, partially preserved stolons in three portions of stipes where periderm is degenerate; AM F123400. b, *Stelechocladia* sp. cf. *S. praeattenuata* Rickards et al., 2003, AM F123408a. c, *Acanthograptus praedeckeri* Rickards et al., 2003, AM F123410. d-e, ?*Rhabdopleura* sp., respectively AM F123412-3; both exhibit stolons with possible preserved soft tissue (encysted zooidal attached). f, *Callograptus* sp. aff. *C. ulahensis* Rickards et al., 2003; AM F123407. Scale bars 1mm; stipple on Fig. a indicates possible attached soft parts. Scale bars 25 mm (a), 1 mm (b-f).

mm; dissepiments slender, 0.05-0.10 mm, 14-20 in 10 mm. Dissepiments conspicuous because of their frequency; proximally they are more robust and perhaps sparser. Bithecal tubes seen in places but their apertural regions are difficult to discern; they may be of the type described by Bulman (1928) in *D. falciferum* where the bithecal apertural region hooks over the dorsal apertural region of the autotheca. Alternatively, they may grow short of the full hook (Fig. 3e); bithecal tubes 0.05 mm wide.

Remarks

Rickards et al. (2003) considered the original material from Four Mile Creek probably had conical rhabdosomes but it seems more likely that they are fan-shaped. Bulman (1928) could not see the nature of the rhabdosome as a whole in the type subspecies, and he was particularly vague about the nature of the bithecae: otherwise the type subspecies is clearly close to the Australian form differing only as outlined by Rickards et al. (2003). *Dictyonema paululum australis* is the most common dendroid at Cotton Hill Quarry

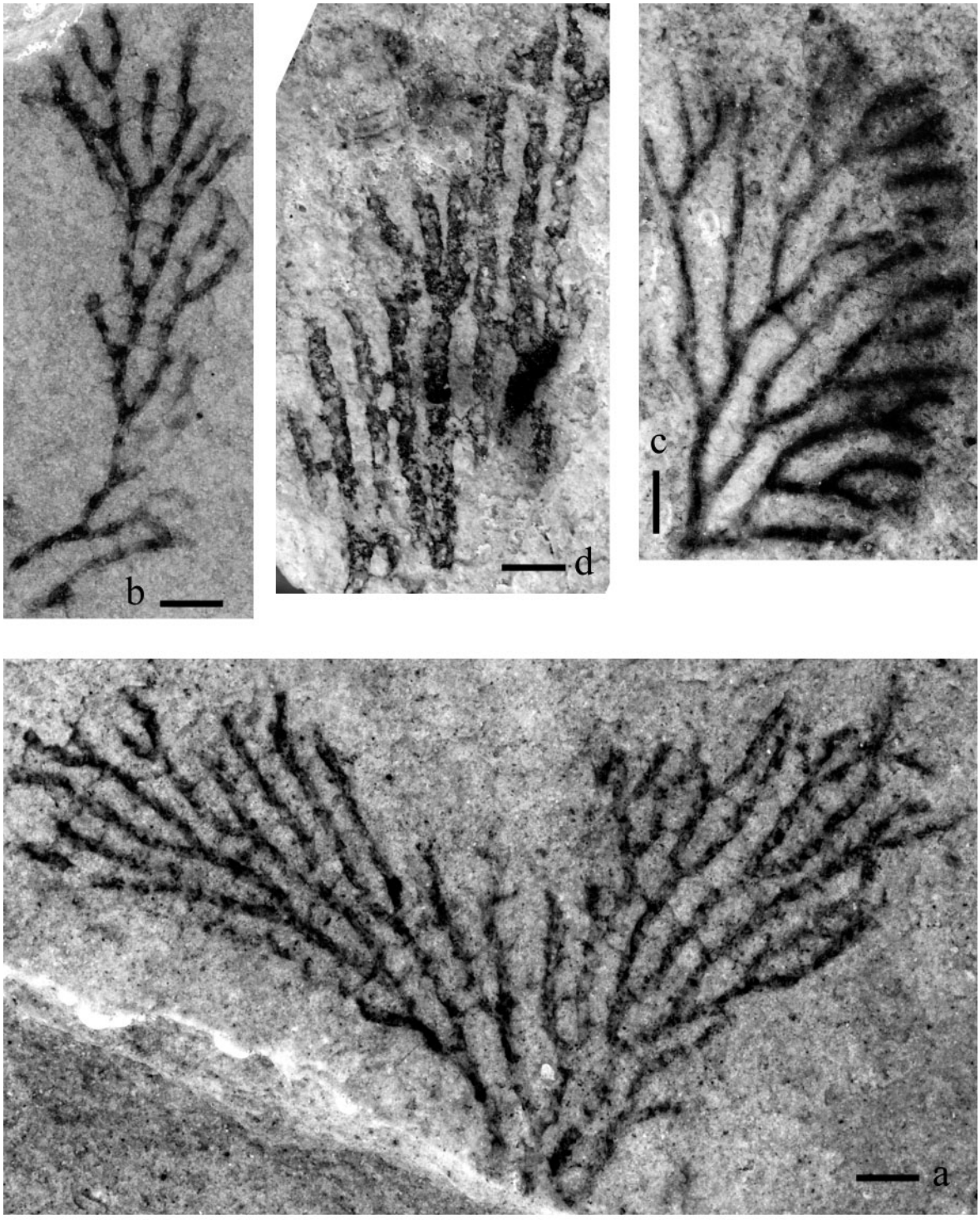

Figure 6. a-b, *Dictyonema* sp. aff. *D. paululum australis* Rickards et al., 2003; respectively AM F123395, AM F123396. c, *Callograptus rigbyae* Rickards et al., 2003; AM F123405. d, *Dictyonema* sp. aff. *D.* sp. cf. *D. venustum* Bulman, 1928; AM F123398. Scale bars 1 mm.

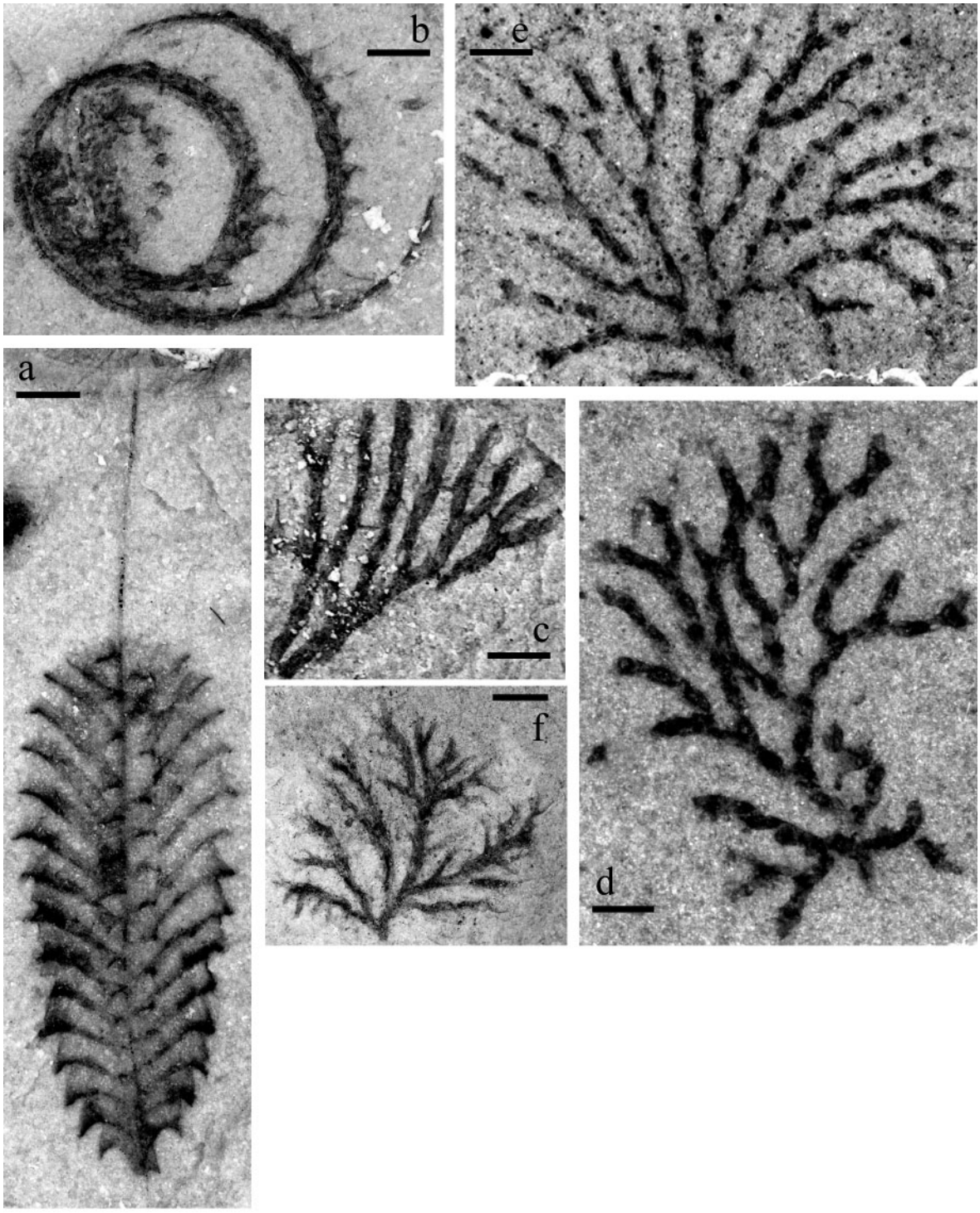

Figure 7. a, *Parapetalolithograptus palmeus* (Barrande, 1850) s.l., AM F123428. b, *Spirograptus turriculatus* (Barrande, 1850), AM F123427. c, *Dictyonema paululum australis* Rickards et al., 2003; AM F123384. d-e, *Callograptus rigbyae* Rickards et al., 2003; respectively AM F123404, AM F 123406. f, *Acanthograptus praedeckeri,* AM F123409. Scale bars 1 mm.

(and see also *D*. sp. aff. *D*. *p*. *australis* described below). *Dictyonema paululum hanoverense* Rickards et al., 2005 from the Late Silurian *parultimus* Zone near Neurea, N.S.W. differs in having an autothecal spacing of 28-30 in 10 mm and quite spinose ventral apertures.

Dictyonema sp. aff. *D. paululum australis* Rickards et al., 2003

Figure 6a-b

Synonymy

aff. 2003 *Dictyonema paululum australis* subsp. nov.; Rickards et al., p. 316, figs 7F-G, 9E, 12A.

Material

AM F123394-6, 123415a-b.

Description

Nature of colony uncertain, possibly fan-shaped. Stipes with lateral width of 0.20-0.25 mm, and spaced at 20-22 in 10 mm, more or less parallel, and with interstipe spaces of 0.20-0.40 mm; branching roughly in zones every 1.0-2.5 mm. Autothecae spaced at 19-20 in 10 mm; dorsoventral width uncertain but may be *ca.* 0.50 mm. Bithecae not detected. Dissepiments fine, spaced at *ca.* 20 in 10 mm.

Remarks

These specimens are superficially similar to those of the *D*. *paululum australis* material described in this paper, except that the stipes are more closely spaced and the interstipe spaces concomitantly narrow. There may be a temporal subspeciation factor involved here as the source level in the quarry for the specimens is uncertain; thus some of the *D. p. australis* specimens may be from older beds and others from the *turriculatus* level.

Dictyonema venustum Lapworth, 1881

Figure 4b

Synonymy

1881 *Dictyonema venustum* sp. nov.; Lapworth, pp. 171-2, pl. 7, fig. 1a-c

1928 *Dictyonema venustum,* Lapworth, emend; Bulman, pp. 61-3, pl. 5, figs 6-7, ?8, text-fig 34.

2003 *Dictyonema venustum* Lapworth, 1881; Rickards et al., pp. 315-6, figs 7A, 9D, 10B-D.

Material

An almost complete rhabdosome, AM F123397, plus AM F123416-7.

Description

Rhabdosome conical, reaching 8 mm x 8 mm; very proximal end missing though part of the holdfast may be present. Stipes with lateral width of 0.25-0.30 mm, dorsoventral width of 0.70 mm, and spaced at 16 in 10 mm. Interstipe spaces rectangular, up to 0.50 mm wide, and are bounded by stipes and dissepiments spaced at 5-8 in 10 mm. Dissepiments relatively robust, up to 0.15 mm thick. Autothecal spacing 16 in 10 mm; thecae appear to be denticulate but otherwise simple. Bithecal tubes present but relationships to autothecal apertures not seen.

Remarks

The specimen is very close to the type material redefined by Bulman (1928), differing only in a slightly closer spacing of the stipes.

Dictyonema sp. aff. *D*. sp. cf. *venustum* Bulman, 1928

Figures 1b, 6d

Synonymy

aff. 1928. *Dictyonema* cf. *venustum* Lapworth, emend.; Bulman, pp. 62-3, pl. 5, fig. 8 (*non* 6-7).

Material

AM F123398; three other specimens (AM F123424-6) questionably assigned here.

Description

The large fragmental rhabdosome (AM F123398) has 12 stipes preserved, spaced at 16 in 10 mm, with interstipe spaces of 0.10-0.40 mm, and spaced at *ca.* 1-6 in 10 mm. Lateral stipe width 0.25 -0.40 mm, usually nearer the latter. Autothecae unclear but may be spaced at *ca.* 20 in 10 mm with dorsoventral width of 0.50 mm.

Remarks

This specimen is very close to that figured by Bulman (1928, pl. 5, fig. 8) which he listed as *D. venustum* but he made it clear in the text that he placed it there only with reserve. As in the Cotton Hill quarry specimen the interstipe spacing is less and the stipes are more robust. The Girvan specimens illustrated by Bulman were said to come from *communis* zone beds (probably *convolutus-sedgwickii* zone in modern terminology); thus they may have come from pre-*turriculatus* Zone strata, and this is also possible in the case of the present specimen.

Dictyonema sp. cf. *D. falciferum* Bulman, 1928

Figures 3d, 5a

Synonymy

cf. 1928 *Dictyonema falciferum* n. sp.; Bulman, pp. 53-6, pl. 5, figs 1-3, text-figs 27-29.

cf. 2003 *Dictyonema falciferum* Bulman, 1928; Rickards et al., p. 315, figs 5I, 8B, 9C, 10A.

Material

AM F123399-123401.

Description

Rhabdosome possibly fan-shaped (?conical), at least 25mm long and 18 mm broad, with numerous parallel stipes spaced at 14 in 10 mm, having stipe interspaces of 0.50-0.60 mm. Rectangular meshes are defined by stipes and conspicuous dissepiments spaced at 8-10 in 10 mm. Autothecal spacing 20 in 10 mm. Lateral stipe width 0.20-0.25 mm, and dorsoventral stipe width 0.50 mm. Autothecae appear to be simple denticulate but not spinose. Bithecal tubes present but their apertural regions unclear. Branching rather irregular, at 0.5-5.0 mm intervals.

Remarks

These specimens are closely similar to the specimens described from Four Mile Creek by Rickards et al. (2003) differing only in having a less regular branching pattern and slightly more parallel stipes. One specimen (AM F123400; Fig. 5a) has traces of preserved stolons.

Dictyonema zalasiewiczi sp. nov.

Figures 1c, 4a

Material

Holotype, AM F123402, an almost complete rhabdosome.

Derivation of name

After Dr. J. Zalasiewicz, University of Leicester, a leading graptolite worker.

Diagnosis

A *Dictyonema* species with 30-40 dissepiments in10 mm; stipes 0.2-0.5 mm wide and spaced at 0.2-0.3 mm.

Description

Fan-shaped rhabdosome more than 30 mm long and over 20 mm wide, typified by its striking number of dissepiments, up to 40 per 10 mm, never less than 30. Dissepiments 0.05-0.10 mm across, often arched distally, and quite frequently branching; commonly angled rather than normal to adjacent stipes, but also occur as closely spaced pairs. Stipes uniformly 0.20-0.25 mm in lateral width, with branching every 2-2.5 mm proximally and more sparse distally, up to 6 mm. Branching occurs in broad zones. Stipes parallel and closely spaced, with interstipe spaces of 0.20-0.30 mm, similar to the lateral width, resulting in a stipe spacing of about 20 in 10 mm. Autothecal spacing difficult to discern in this dorsoventral view, but may be around 20 in 10 mm. Nature of autothecal apertures cannot be seen, except in one area where they appear to be denticulate or spinose. Bithecae not detected.

Remarks

This is a highly unusual and distinctive species because of the huge number of dissepiments. Bulman (1928, table II) gave only two species of Silurian dictyonemids with as many as 20 dissepiments in 10 mm (and none with this frequency in the Ordovician species; Bulman 1928, table I). Of Australian dictyonemids, Rickards and Wright (1997) and Rickards et al. (2003), for example, only once have dissepimental spacings as high as 30 in 10 mm been recorded, and that in some specimens of *Dictyonema delicatulum barnbyensis* from the middle to upper Ludlow; a few other Australian species have as many as 20 in 10 mm. *Dictyonema paululum australis* Rickards et al., 2003 is similar in having conspicuous dissepiments, but their spacing and that of the stipes is quite different. None of Bouček's (1957) dictyonemids has high dissepimental spacings.

Callograptus J. Hall, 1865

Type species

Callograptus elegans J. Hall, 1865, by original designation.

Callograptus bridgecreekensis Rickards et al., 2003

Figures 1d, 3b

Synonymy

2003 *Callograptus bridgecreekensis* n. sp.; Rickards et al., p. 319, figs 14A, 15A-B.

Material

AM F123403.

Description

These 13 or so stipes are towards the distal end of a moderately-sized (8 mm x 5 mm) piece of rhabdosome; lateral stipe width of 0.50 mm most

proximally, and 0.20 mm at distal ends of stipes. Branching irregular, stipe spacing over 20 in 10 mm. No dissepiments. Autothecae not detected in this wholly dorsoventral view, but traces of bithecal tubes apparent.

***Callograptus rigbyae* Rickards et al., 2003**
Figures 1e, 6c, 7d-e

Synonymy
2003 *Callograptus rigbyae* n. sp. Rickards et al., p. 319, figs 14B-C.

Material
Four almost complete colonies, AM F123404-6, 123414, plus AM F123419-123421.

Description
Fan-shaped or discoidal colony about 10 mm across, developed from a small holdfast. Up to 6 branching zones may occur in this short distance giving numerous peripheral stipes. Rare anastomosis of stipes. Interstipe spacing 0.50 mm; stipe spacing *ca*. 16 in 10 mm, lateral stipe width 0.20-0.30 mm. Autothecae spaced at 20 in 10 mm, and autothecal apertures bear a ventral spine up to 0.50 mm long. Dissepiments rare, and extremely fine. Bithecae occur, but their nature is unclear.

Remarks
The original specimens from Bridge Creek (Rickards et al. 2003, p. 319) were two colonies preserved in plan view. Two Cotton Hill specimens (Figs 7d-e) are more in profile. One (AM F123404a-b: Fig. 7d) shows the autothecae best and a short spine can be clearly seen. Bithecae were not detected in the original material.

***Callograptus* sp. aff. *C. ulahensis* Rickards et al., 2003**
Figures 3c, 5f

Synonymy
aff. 2003 *Callograptus ulahensis* n. sp.; Rickards et al., pp. 319-20, figs 16A, 17A.

Material
A small fragment of rhabdosome, AM F123407, comprising nine stipes.

Description
The initial two parallel stipes branch after 3 mm, but thereafter branch at 1-1.5 mm intervals resulting in short, parallel stipes with lateral width of 0.20 mm. Interstipe spaces *ca.* 0.50 mm, and stipe spacing *ca*. 20 in 10 mm. Autothecal spacing 20 in 10 mm; dorsoventral width may be 0.40-0.50 mm and thecal aperture may be denticulate. No dissepiments present.

Remarks
This specimen adds a little to the original description which was based upon two specimens (AM F114760 and 114780) from locality BF15, some 100 m S of the junction of Four Mile Creek and its tributary Bridge Creek (Rickards et al. 2003). The autothecae are not so clear in the Cotton Hill Quarry specimen, but the disposition of the stipes is more apparent.

Family Stelechocladiidae Chapman et al., 1993

***Stelechocladia* Počta, 1894**

Type species
Stelechocladia subfruticosa Počta, 1894, subsequently designated by Bouček (1957).

***Stelechocladia* sp. cf. *S. praeattenuata* Rickards et al., 2003**
Figure 5b

Synonymy
cf. 2003 *Stelechocladia praeattenuata* n. sp.; Rickards et al., p. 322, figs 17B, 19A-B.

Material
AM F123408a-b, and AM F123422-3.

Description
AM F123408 is the distal end of a stelechocladiid with stipes spaced at 16 in 10 mm, some apparently laterally derived from nearby dominant stipes. Lateral stipe width from 0.20-0.40 mm, the more robust stipes being more proximal. Branching, where it occurs, is almost every mm, but long, unbranched portions also occur. Autothecae not seen.

Remarks
This form is almost certainly referable to *S. praeattenuata,* having the typical combination of dichotomous and "lateral" branching as well as the dimension of a distal part of that species' rhabdosome. Lack of autothecal presentation, however, urges caution.

Family Acanthograptidae Bulman, 1938

***Acanthograptus* Spencer, 1878**

Type species

Acanthograptus granti Spencer, 1878, by original designation.

***Acanthograptus praedeckeri* Rickards et al., 2003**

Figures 2c-d, 5c, 7f

Synonymy

2003 *Acanthograptus praedeckeri* n. sp.; Rickards et al., pp. 322-5, figs 17C-D, 19C, 20A- (not fig. 18A).

2003 *Dictyonema warrisi*; Rickards et al., fig. 18A (mislabelled).

Material

Three specimens, including one almost entire, small rhabdosome (AM F 123409, Fig. 7f): AM F123409-11.

Description

Twigs arranged at 8-16 in 10 mm, each 0.70-1.00 mm long and comprising two or more thecae. Main stipes 0.40-0.50 mm wide laterally, and their ramifications fill all the space available to form a flabellate or fan-shaped colony. Branching occurs every 0.50-2.0 mm, usually 1.00-1.50 mm. Autothecal tubes 0.10 mm wide and do not seem to expand towards apertures. Bithecae may be not much smaller and may open near bases of twigs or on main stipe.

Remarks

The caption for Rickards et al. (2003, fig. 18A) wrongly states that the illustrated species is *Dictyonema warrisi,* really being *Acanthograptus praedeckeri*.

Class Rhabdopleurina Fowler, 1892
Family Rhadopleuridae Harmer, 1905

***Rhabdopleura* Allman, 1869**

Type species

R. normani Allman, 1869.

?*Rhabdopleura* sp.

Figures 5d-e

Material

AM F1123412-3; the latter has a fragment of *Callograptus rigbyae* on the reverse side (AM F123414).

Description

The larger specimen (AM F123412: Fig. 5d) appears to have a basal thecorhiza from which arise about nine tubes with a diameter of 0.15-0.20 mm. Tubes distally less sclerotised. Suggestion of growth lines in places, especially on AM F123413 (Fig. 5e). In thecorhizal portion there are probably pyritised (non-goethitised) stolons and possibly also attached encysted zooids. Distal parts of tubes (coenecia) unoccupied and may represent free-standing parts of tubes. AM F123413 may also have pyritised stolons and zooidal remains.

Remarks

This form does not resemble tuboids such as *Galeograptus* and *Cyclograptus* which we have previously recorded from Australia (Rickards et al. 1995, 2003). Were it not for the uncertainty about the growth lines we would refer this to *Rhabdopleura* with more confidence. *Rhabdopleura* has not previously been recorded in Australian strata.

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